SCOPE OF WORK

TO PERFORM

INTERMIM ENVIRONMENTAL STUDIES ON

TRACT-a

FOR

RIO BLANCO OIL SHALE PROJECT

NUS CORPORATION

SCOPE OF WORK

TO PERFORM

INTERIM ENVIRONMENTAL STUDIES ON

TRACT C-a

FOR

RIO BLANCO OIL SHALE PROJECT

SUBMITTED BY

NUS CORPORATION
DENVER, COLORADO

DECEMBER 15, 1976

PAUL V. MORGAN
VICE PRESIDENT AND GENERAL MANAGER
ECOLOGICAL SCIENCES DIVISION

TABLE OF CONTENTS

I. INTRODUCTION

This scope of work reflects the effort proposed by NUS Corporation to perform interim environmental baseline studies and revisions of the RBOSP detailed development plan (DDP) in our revised proposal number 76.10.067R dated December 15, 1976. Section 2 includes the scopes of work for the air, terrestrial, hydrology, and aquatic studies. Section 3 contains description of interim and baseline data analysis. Section 4 is a discussion of the report integration phase and schedules for accomplishing the work are presented in Section 5. Revisions required for the DDP are presented in Section 6 as an addendum.

PART 2

SCOPES OF WORK

2.1 Air Studies

Air studies to be conducted during the Interim Monitoring Program include the acquisition of additional meteorological and air quality data, data analysis, review and refinement of site diffusion modeling, and the review and appropriate modification of the air quality sections of the Detailed Development Plan. These studies are designed to optimize additional data collection efforts, minimize expenditure, and develop defensible rationale for air quality monitoring and control during future site development.

2.1.1 Objectives

The objectives of the interim environmental monitoring programs are;

- acquire meteorology and air quality data for the period February 1, 1977 through August 31, 1977.
- identify conditions under which anomalous data have been acquired during the entire monitoring period.
- specify in greater detail the natural climatic, meteorological and air quality environment on the tract.
- establish the basis for revision of the detailed development monitoring plan to improve the selection of monitoring parameters to insure the accurate assessment of the trace area environment with the minimum expenditure of resources.
- integrate baseline and interim data into a consolidated assessment report.

2.1.2 Methods

The methods that will be used to accomplish the objectives will provide data accuracy traceable to the National Bureau of Standards, documented data validation, rigorous statistical analysis, integrated presentation, significant correlations between environmental parameters, and concise, factual reports of progress, conclusions, and recommendations. All work will be performed in accordance with a work plan developed by NUS and approved by RBOSP.

2.1.2.1 Data Accumulation

NUS will operate, calibrate and maintain the meteorology and air quality instrumentation installed at Site 1 on Tract C-a using the currently installed instrumentation and data acquisition facilities. This equipment will provide continuous measurements of the ambient air quality by detecting and quantifying the concentration of THC, CH_4, SO_2, H_2S, NO, NO_x, CO, and O_3. The data will be recorded on strip charts and concurrently automatically averaged for hourly intervals by an automatic data acquisition system. In addition to the air quality data, NUS will calibrate and maintain meteorological monitoring equipment to measure:

- at what intervals

wind speed (10, 30 and 60m levels)

wind direction (10, 30 and 60m levels)

wind direction sigma (10m level)

air temperature (10 and 30m levels)

temperature difference (between the 60m and 10m levels)

relative humidity (10m level)

surface precipitation

NUS will provide a capable, trained site technician who will be thoroughly familiar with both the meteorological and air quality monitoring sensors, and all of the ancillary equipment necessary for their operation. At no expense to RBOSP, NUS plans to send the site technician to a Bendix training program in order to further increase his knowledge of and experience with equipment of the type installed at Site 1. The technician proposed by NUS is a qualified meteorologist who will also perform initial review and analysis services on the field data. In addition, NUS will provide technical supervision and review over all site activities of the site technician.

The site technician, along with supervising engineering personnel, will visit the site for a minimum of one week prior to February 1, 1977 for the purpose of a complete station check out. During this period, all of the equipment will be examined in detail, tested, and certified using test and calibration equipment with certified traceability of accuracy to the National Bureau of Standards. The tests will be conducted to an approved work plan which will result in complete documentation of items such as sensor locations, orientations, sensitivity, range, and minimum detectable levels; and in electrical and electronic calibration of recorders, analog to digital converters, sensor translators, integrators and signal processing circuits.

This test and calibration program will constitute the initial calibration of the system at the outset of the interim data monitoring period and will provide the benchmark for the data validation process. Comparisons will be made between strip chart recorded parameters and the automatic data system by spot sampling and averaging data to establish the relationship between basic and "fill-in" data when strip chart data are required to back-up the automatic data system.

NUS will provide the site technician with written detailed work instructions covering each sensor system. These instructions will incorporate NUS QA controls which satisfy the requirements of 10 CFR 50, Appendix B, and are consistent with the EPA Quality Assurance Handbook for Air Pollution Measurement, Volume I. The site technician will have received training and checkout in the exercise of each procedure and in the proper methods of entering site information into site and personal logs. A formal checklist will accompany each procedure. The check lists will be completed in duplicate, one copy will be maintained off-site for safety of records reasons. NUS will provide rubber stamps for the annotation of strip chart records during site visits. This procedure insures that all necessary data are available for review when strip chart data are used for data fill-in or data validation.

NUS will provide the site technician with accurately pre-weighed total suspended particulate matter filters, properly indexed and controlled. The filters, after exposure, will be returned to the NUS air quality laboratory for conditioning and weighing.

NUS will employ the Federal reference method for the measurement of Total Suspended Particulate which includes filter pH control, desiccation, standardization of balances with certified Class S weights, sample flow normalization, orifice plate calibration of sampling flow, and qualitative observations on the character of the deposits collected on the sampling filter. The filters will be maintained on file at the NUS Air Quality Laboratory for future reference in the event it is desired to determine the composition of the collected samples.

Site data, both chart records and magnetic tape, will be retrieved from the site on a bi-weekly basis. The site technician will command a tape dump to the high-speed printer or teletype to obtain a hard copy of the tape recorded data prior to removal and substitution of the tape record. The strip charts, exposed particulate filters, and the magnetic tape reel will be forwarded to the NUS facility in Rockville, Maryland, by registered mail in separate enclosures on separate days. Upon receipt, the data are logged in under a quality assurance follow-up system that prevents data loss or diversion.

Meterological and air quality data review, reasonablenese tests, data make-up and validation, and quality assurance tests will be performed by the site technician, who will be a qualified meterologist. Reviewed data will be transmitted to the NUS facility in Rockville, Maryland, in completed form. If the site technician is temporarily replaced (i.e. illness) with emergency back-up personnel, the data review function will be performed by trained analysts in Rockville. In all cases the data will receive a supervisory review, and comments will be transmitted to the site technician when tests or system measurements are desired to justify, verify, or supplement the data.

Field data are considered as raw data. Data adjustments or corrections may be applied if instrument drift or span change can be established by a valid test. The NUS site technician may be directed at any time to perform a test or recalibration for the purpose of establishing a correction factor. All alterations to raw data will be justified and completely documented. NUS will defend the accuracy of all data acquired during the interim monitoring program. Spot checks will be made to compare strip chart backup records with automatic data system data listings for the same time intervals. Confidence limits will be established for both recording methods.

2.1.2.2 Calibration and Maintenance

The complete environmental monitoring system will be reviewed upon assumption of responsibility by NUS. All sensor parameters, including installation, orientation, sensitivity, range, and limits of detectability will be measured. Federal EPA reference methods will be used to establish equivalency or comparability for all site instrumentation. For the air quality instruments this will involve dynamic calibration with standard gasses for THC, CH_4 and CO, and certified permeation devices for H_2S, NO_x and SO_2. Ozone calibration will be determined by neutral Potassium-Iodide wet chemical methods and an ultraviolet ozone generator. Calibration procedures will be covered by detailed work instructions for each sensing system. Calibration devices and ambient air samples will be validated on site during the calibration of the air monitoring instruments. Validation will be performed by sampling instrument intake streams with replicate wet chemical analysis of composition using the pararosanaline method for SO_2, a modified Saltzman reagent for NO_2, and lead acetate titration for H_2S. Complete documentation of all tests and results will be prepared for project files in accordance with QA requirements. These calibrations will be performed on a weekly basis by the site technician.

NUS will obtain National Oceanographic Instrumentation Center (NOIC) calibration of wind sensors prior to replacement installation on a quarterly basis. Spare calibrated wind sensors will be maintained on-site for emergency maintenance.

The temperature sensors and the differential temperature measurement sensors will be calibrated against a certified precision quartz thermometer in a controlled temperature bath. The differential temperature measurement accuracy directly affects the estimate of the real-time atmospheric stability and is critical in the evaluation of diffusion models.

The humidity sensor will be calibrated using standard saturated atmospheres produced by salt solutions in equilbrium with a volume of air containing the sensor element. The initial calibration report will establish the Interim Monitoring Program benchmark. This evaluation may be extended backwards in the data analysis program to evaluate baseline data. NUS will establish a correlation between interim and baseline data for predictable parameters and establish correlation validation of existing data.

NUS will provide all of the test and calibration equipment required for maintaining the equipment on the site, with the exception of the air conditioning equipment. No equipment will be purchased for use in the Interim Monitoring Program.

NUS will additionally perform system recalibrations on a quarterly basis. Installation of replacement calibrated wind sensors and other preventative maintenance will be performed during the quarterly calibration visits. Routine maintenance will be provided by the site technician according to a written work plan. The most important function of the technician will be emergency maintenance, occasioned by catastrophic failures of sensor system. If necessary, NUS will obtain maintenance support from the equipment manufacturer or will dispatch a maintenance engineer from our Air Quality laboratory. Adequate spare parts exist for the replacement of any sensor system. NUS will arrange for the inventory, and failure-tree guidance for component replacement.

2.1.3 Sampling Frequency

Meteorological and gaseous air quality parameters will be collected continuously. Airborn particulates will be collected every sixth day.

The site technician will visit the site for two days at least every sixth day.

2.1.4 Data Analysis and Reports

The interim monitoring period data will be reduced, validated, and recorded in a permanent format. The data will be recorded on an IBM compatible magnetic tape. In accordance with standard QA controls, data will be stored in two separate physical locations for security. NUS data analysis computer programs routinely calculate for each air quality parameter means, maximums, standard deviation, second highest value, seasonal and annual data set summaries, and plots the cumulative frequency of occurrence of concentration values in the data set. These calculations are an aid to reviewing the data for outliers, trends or systematic biases. All baseline data will be processed by the same NUS data analysis computer program to provide a consistant format for comparison and evaluation.

Correlation analysis of interim monitoring period data will be conducted to show the degree of relationship between reasonably linked parameters. For instance, NUS will provide a statistical program for the evaluation of singular high concentrations of total suspended particulate matter. Linear and non-linear regression analysis will be performed for parameter combinations such as wind speed and direction versus length of time since previous significant precipitation. If all reasonable mechanisms for the presence of particulate can be ruled out, then the reason for the observation may be ascribed to unmonitored sources, e.g., uncontrolled site access resulting in surface disturbances producing excessive particulate during a sampling period.

NUS will analyze the total oxidant (ozone) data in terms of site synoptic meteorology and climatology to determine whether the ozone measurement is of local or stratospheric origin. Correlation of seasonal hydrocarbon data with ground cover life cycle will be performed to demonstrate the natural origin of excess hydrocarbon concentration in the ambient air.

NUS will provide the interface between the Colorado Department of Health, Division of Air Pollution Control, Area Oil Shale Supervisor, and the Federal EPA for the review of calibration procedures and results. Where possible, regulatory personnel will witness calibration procedures. As a minimum, NUS personnel will visit appropriate regulatory agencies, in the company of RBOSP representatives, and review the plans for the Interim Monitoring Program. This review should be conducted at the outset of the program to obtain agency concurrence.

2.1.4.1 Baseline Data Analysis

NUS will review all original meteorological baseline data obtained at Site 1 on Tract C-a. This will provide the background for testing the Interim Monitoring Program data for correlation with subsequent seasonal data. NUS will prepare joint frequency distributions (JFD) for each month. The year to year JFD comparisons are a sensitive indication and differences in climate, and the JFD's are used in the computation of average low level diffusion parameters. NUS will use the 60m - 10m temperature difference as the preferred estimator of atmospheric stability.

NUS will evaluate the topography of the Site 1 location to assess the influence of local surface conditions upon the atmospheric stability estimated from the measured data. Examination of the baseline data summaries shows what appear to be unusually high positive delta T values. One possible explanation of this observation is that, due to the small area of the plateau and the fall off of terrain on all sides of Site 1, radiation and surface cooling causes an especially rapid draining away of the lower levels in the atmosphere. This may not reflect general site conditions but more of a micrometeorological phenomenon. Such an effect should be incorporated into the diffusion model.

NUS will compare Interim Monitoring Program data with Baseline data to determine whether any significant differences are present. Where any difference exists between the two data sets, the magnitude of the difference will be analyzed and placed into perspective, depending on the parameter. NUS has developed test techniques for both meteorological and air quality data that incorporate accepted variance between data sets depending on the averaging time. The comparisons are displayed graphically and quantified if the variance exceeds preset limits. Each parameter of the Interim Monitoring Program will be compared with its counterpart.

NUS will utilize an IBM 370/168 computer for all computations made with the Interim and Baseline data. NUS regularly uses this facility for other projects of the same nature. Data tapes containing air quality and meteorological data will be submitted to RBOSP on 9 track, 800 bpi record tapes with complete documentation of the format. The air quality and meteorology data will be merged. All recorded data will be in engineering units.

2.1.4.2 Reports

NUS will furnish RBOSP the meteorological and air quality data on a semi-annual basis. Data listings will be appended to the Interim Monitoring Program semi-annual reports. Data tapes containing all the raw data for the reporting period will also be provided. Because the meteorology and air quality data collection will not begin until February 1, 1977, the first semi-annual report and data tapes will contain only one month of field data.

NUS will prepare for the first semi-annual report a detailed description of and rationale for the Interim Monitoring Program as it relates to meteorological and air quality measurements and analysis. Both objectives and methods will be discussed. Comparisons between baseline and interim data will be made and significant deviations from baseline data discussed.

The second semi-annual report will contain data listings for the reporting period plus semi-annual and annual summaries. Interim data will be compared statistically to the baseline data and significant deviations will be discussed.

Monthly status reports will be provided to the project manager for inclusion in the monthly progress report submitted to RBOSP (Attachment I).

2.1.5 Air Quality Model Validation Studies

2.1.5.1 Objectives

NUS will review the applicability of mathematical diffusion models used to predict ground level contaminant concentrations for the Detailed Development Plan for the RBOSP, to evaluate the results of tracer studies conducted to validate and calibrate atmospheric transport models, and to recommend additional tracer studies or air quality impact analysis as required.

2.1.5.2 Evaluation of Tracer Studies

The interpretation of the meteorological conditions and measured tracer concentrations during the performance of the tracer test is critical to the validation of the model used to predict ground level concentrations for the Detailed Development Plan.

Accordingly, the design of the experiment will be carefully reviewed in terms of the selected tracer release point, measurement of meteorological conditions, placement of samplers to identify air flow patterns, and methods of data analysis to define dispersion effects.

2.1.5.3 Review of Atmospheric Transport Model

NUS will review the method of application of the EPA Valley model and, in conjunction with evaluation of the tracer test results, to determine if more sophisticated modeling techniques are justified for determination of the Detailed Development Plan. The contribution of individual sources rather than combined sources to the predicted point of maximum concentration will be examined in detail and modifications to the methods of analysis and/or facility design that would reduce ground level concentrations to acceptable levels will be recommended. Comparative analysis will be performed using currently developed EPA models and more advanced NUS developed models for the purpose of determining the requirement to update the Detailed Development Plan. As a part of this review, site meteorological data from the digital data records and analog strip charts will be examined to confirm the selection of conditions of maximum ground level concentration and to examine the degree of persistence of wind direction, stability and wind speed.

NUS will review the Baseline environmental contractor's documentation prepared to jusitfy the selection of the transport model and the tracer study. It is possible that the conditions during the tracer test cannot be adequately simulated by the model utilized in the Detailed Development Plan. If the evaluation of the tracer test results indicates that this is the case, NUS will evaluate the application of more sophisticated model analysis for comparison with the tracer test results.

NUS will provide complete descriptive documentation and calculated results for any models developed in connection with Tract C-a. NUS technical personnel will be available to support representation of modeling assumptions and results to regulatory agency personnel, if required.

2.1.5.4 Fugitive Dust

Sources of fugitive dust will be identified and defined based on projected construction and operation schedules, types of equipment and facilities, and projected vehicular traffic. Fugitive dust dispersion will be calculated using applicable (point, line or area source) transport models for the various emissions. The analysis will be based on EPA accepted studies and the standard literature.

2.1.5.5 Environmental Baseline Data Analysis

NUS will prepare a report summarizing the results of the tracer studies and of the atmospheric transport model review,

2.2 Terrestrial Studies

2.2.1 Range Productivity and Utilization

2.2.1.1 Objectives

Range production and utilization studies will be conducted to measure the actual forage being produced annually per unit area within the following major vegetation types of the Tract C-a and 84 Mesa study area: pinyon-juniper, sagebrush and mixed brush. The amount of forage taken by large herbivores at a given point in time will also be measured. These studies can be used as a guide to indicate the current carrying capacity of the area and to determine the degree to which herbivores have consumed current vegetation production.

2.2.1.2 Methods

Range production and utilization studies will be conducted within the three principal vegetation types on Tract C-a and the 84 Mesa study area: pinyon-juniper, sagebrush and mixed brush. Thirty sampling sites will be established within these major vegetation types during the interim program. Sampling sites will be located on Tract C-a and on 84 Mesa. These sampling sites will encompass a variety of physical parameters such as slope, aspect and elevational variations within a particular vegetation type. When possible, sampling sites will be located in the same general vicinity as the range productivity and utilization baseline studies. A map of the sampling locations will be submitted to RBOSP. Sampling sites will be distributed as follows: pinyon-juniper - 10; sagebrush - 15; and mixed brush - 5. These numbers are subject to revision upon further analysis of data.

Range productivity and utilization estimates will be obtained by using the double sampling method (USDA Forest Service, 1970). Two caged plots (9.6 sq ft in size), and eight unprotected plots (Permanently marked) will be located at each sampling site.

Sampling will be done by a 9.6 sq ft sampling loop on each of 8 unprotected plots. Production of grass and forb species within the loop will be estimated by ocular weight to the nearest gram. The two protected plots will be similarly estimated, then each species within the protected plots will be clipped, bagged separately, weighed green and recorded. Species providing less than one percent biomass will be recorded as present, but will not be weighed. Correction factors will be calculated from the estimated green weights and actual green weights of the clipped plots.

$$\text{CORRECTION FACTOR} = \frac{\text{Actual Green Weight}}{\text{Estimated Green Weight}}$$

These correction factors will be used to correct all estimated values. Clipped samples will be air-dried for approximately 30 days and weighed to obtain moisture percentages. All corrected estimates will then be computed, using these moisture percentages to obtain air-dry forage productivity estimates.

Utilization is calculated as follows:

$$\%\ \text{Utilization} = \frac{\text{Average productivity per ungrazed plot} - \text{Average productivity per grazed plot}}{\text{Average productivity per ungrazed plot}} \times 100$$

2.2.1.3 Sampling Frequency

Field plots will be set up in early spring, 1977. Field measurements will be made upon completion of the growing season in mid-August, 1977. Visual inspection of the range habitat for insect and frost damage will be conducted concurrently during the range productivity and utilization studies.

2.2.1.4 Data Analysis and Reports

Data collected will be presented within a logical time frame after completion of the field effort. After each data collection, dry-weight production (kg/ha and lbs/A), percent utilization and utilized forage production (kg/ha and lbs/A) will be estimated for each of the three vegetation types.

The data will be analyzed to compare forage productivity and utilization between the interim and baseline periods for each vegetation type. The analyzed data will be reported semi-annually. The initial semi-annual report will contain a detailed discussion of the objectives and methods, including location of sample sites, their vegetative characteristics and identification. The above mentioned comparisons shall be discussed and the significance of the results highlighted.

Monthly status reports (Attachment I) will be submitted on the eighth day of the month.

2.2.2 Browse Condition and Utilization

2.2.2.1 Objectives

Browse condition and utilization studies will be conducted in the same general sampling locations as the range productivity and utilization studies to allow integration of these programs.

2.2.2.2 Methods

Browse conditions and utilization studies will be conducted within three principal vegetation types on Tract C-a and 84 Mesa study area: pinyon-juniper, sagebrush, and mixed brush. Thirty sampling sites will be established within these major vegetation types. Locations will be selected on the basis of various physical parameters including slope, aspect and elevational variations within a particular vegetation type. A map of the sampling locations will be submitted to RBOSP. Sampling sites will be distributed as follows: pinyon-juniper - 10; sagebrush - 15; and mixed brush - 5.

At each sampling site 25 individuals of the following key browse species will be examined (Cole 1963): juniper (Juniperus osteosperma), pinyon (Pinus edulis) antelope bitterbrush (Purshia tridentata), snowberry (Symphoricarpos oreophilus) big sagebrush (Artemisia tridentata), and true mountain mahogany (Cercocarpus montanus). Sampling sites will be established by arbitrarily selecting a shrub and permanently marking it. Subsequent shrubs are located along a transect by selecting the closest shrub within a 180° arc of the center of the selected shrub. When 2 or more shrubs are equally distant, the one closest to the starting point of the arc will be selected.

During field sampling, five parameters will be examined and recorded:

Form classes:

1. All available, little or no hedging
2. All available, moderately hedged
3. All available, severely hedged
4. Partially available, little or no hedging
5. Partially available, moderately hedged
6. Partially available, severely hedged
7. Unavailable
8. Dead

Age Classes:

S - seedling - less than 1/8 inch basal diameter
Y - young - 1/8 to 1/4 inch basal diameter
M - mature - over 1/4 inch basal diamter
D - decadent - more than 25% of crown surface is dead

Leader Use Estimates will be based on the percent of twigs or leaders which are available and show use:

Recorded Values	Percentage Ranges
0	
5	1 - 9
25	10 - 39
50	40 - 59
75	60 - 89
95	90 - 100

Hedging Classification will be based upon the length and appearance (hedging) of the previous year's growth (the two-year old wood).

1. None to light
2. Moderate
3. Severe

Availability will be visual estimation of the percent of the plant available to deer as browse,i.e., that proportion less than six feet high.

2.2.2.3 Sampling Frequency

Browse plots will be visited three times-once in the fall (1976) to set up plots and mark and measure plants, once in the spring (1977) to measure the amount of deer use during winter, and again in the fall (August 1977) to measure use by domestic cattle.

2.2.2.4 Data Reduction and Analysis

Form and age class data will be expressed as percentages and leader use estimates will be expressed as an average. Condition ratings will be assigned to sampled browse plants by the following criteria:

Percent of Severely Hedged or Decadent Plants	Condition Rating
0 - 10	Excellent
11- 20	Good
21- 30	Fair
31- 50	Poor
50 Plus	Very Poor

Where appropriate browse condition and utilization for the interim and baseline periods will be compared for each vegetation type.

2.2.3 Mule Deer Studies

2.2.3.1 Objectives

Two years of baseline data have been previously collected on the relative abundance and distribution of mule deer in the study area. The methods employed included aerial censuses and traditional pellet plots. Extensive amounts of data have been collected and analyzed. The primary purpose of this interim study will be to detect any major deviations in mule deer numbers and distribution from existing baseline conditions over the last two years. NUS will consult with CDOW and discuss CDOW findings concerning the study area.

2.2.3.2 Methods

A modified "plotless" method will be employed in the interim monitoring program as defined by Batcheler (1975). Although plot sizes are established, they only define which pellet groups are appropriate for analysis and provide a reference location for future studies. The following equation will be used in estimating deer population abundance:

$$P = \frac{(M_2 - M_1 k_2 k_1)\ \log_e (k_1 k_2}{(1 - k_2/k_1)\ d\ T}$$

Where:

M_1 = pellet count at t_1

M_2 = pellet count at t_2

k_1 = subsamples of pellets marked at t_1

k_2 = The number of remaining k_1 pellets at t_2

d = defecation rate (no.groups/day) (Neff,1968)

T = interval during which all pellets are deposited

P = number of mule deer

Sampling will occur during the fall and spring to estimate deer abundance and distribution for summer and winter. Initial establishment of the plots will include marking of pellets. Each pellet group will be sprayed with a highly visible, durable paint and colored stones will be placed in each group (Kufeld, 1968). Separate colors will be used to differentiate groups marked in fall and spring. Three pellet group sampling transects will established in Tract C-a and 84 Mesa study area; one each in the sagebrush, pinyon-juniper and mixed brush vegetation types.

random plot locations
adequate sample #

Each transect will include 25 circular plots of 4 m^2 each. Sample points will be established every 20 m along the transect and a search will be made up to 6 m around each point for the centroid of the nearest pellet group. The plot center will be marked with a numbered metal stake. Considerations in plot location will include slope, aspect and phytosociology of the area. In order to provide proper comparision and integration of data, deer pellet plot sampling locations will be situated in the same general vicinity as previously described range analysis sampling locations.

2.2.3.3 Sampling Frequency

Pellet plots will be visited in the spring (1977) and fall (1976 and 1977) by NUS. Plots will be established during the first visit (fall 1976) and counted during the spring (1977) and fall (1977) visits.

2.2.3.4 Data Analysis and Reports

Data collected will be presented within a logical time frame after completion of the field effort. After each data collection period, the raw data on number of pellets per plot, and the estimate of deer density in each vegetation type will be presented. Where possible, the pellet data and deer density data will be correlated with the browse utilization data from Section 2.2.2.4, and with the pellet and aerial survey data from the baseline studies.

In additon to the correlations with other data, variations in pellet densities between the three vegetation types will be described.

The analysed data will be reported semi-annually. The initial semi-annual report will contain a detailed discussion of the objectives and methods, including a map of pellet sample sites, vegetative types, aspect and identification.

Monthly status reports (Attachment I) will be submitted on the eighth day of the month.

2.2.4 Small Mammal Studies

2.2.4.1 Objectives

RSOSP has been conducting extensive small mammal studies during the 2-year baseline data accumulation program. Sampling techniques utilized during the period have included live and snap trapping collections. As a result of these studies, vast amounts of data have been collected on species presence and distribution, community composition, food utilization and reproductive effort. A limited small mammal live trapping program will be conducted during the interim monitoring program

while baseline data are being analyzed. The objectives of this program will be to attempt to detect changes from established baseline community composition and species densities of Tract C-a small mammal populations.

2.2.4.2 Methods

Modified North American Census of Small Mammals (NACSM) live trap lines will be used to census small mammal populations once annually (late spring 1977) during the interim monitoring period. The NACSM trap line will consist of two parallel lines 15 meters apart, with 20 trap stations per line placed 15 meters apart. There will be three traps at each station, two "Sherman" type mouse traps and one wire-type squirrel trap. Traps will be baited with rolled oats, grain or other suitable bait. Cotton will be provided as a nesting material and all traps will be covered to prevent death of captured animals due to the elements.

All trap stations will be prebaited at least 24 hours prior to initiation of trapping. Mouse traps will be set in the evening and checked in the morning; squirrel traps will be set in the morning and checked in the evening. Trapping will be conducted for 3 consecutive 24-hour periods. If, on the third day, captures of new individuals of predominant species (deer mouse, pinon mouse, least chipmunk, Colorado chipmunk, golden-mantled ground squirrel, thirteen-lined ground squirrel) equal or exceed 50% of total captures for that day, then the SOW will be amended with RSOSP approval to extend trapping until the number of new captures falls below 50% of total captures for the day (not to exceed 3 additonal days of trapping).

All animals captured will be identified to species, sexed, marked (if previously unmarked) with a unique toe clip combination, reproductive status checked and released. Data recorded for each individual animal captured will include species, sex, toe clip number, reproductive status, and trap location. (Weight is not included because this cannot be used to estimate population levels).

Three sets of NACSM trap lines will be established during interim monitoring, one in each of the three major habitat (vegetation) types on the Tract C-a and 84 Mesa study area. In order to provide proper comparison and integration of data, the small mammal sampling locations will be situated in the same general vicinity as previously discussed range analysis sampling locations.

2.2.4.3 Sampling Frequency

Small mammal trapping will be conducted once during late spring (1977).

2.2.4.4 Data Analysis and Reports

Data collected will be presented within a logical time frame (as agreed between NUS and RBOSP) after the completion of the field effort. After the data collection period, the raw data on the small mammal captures including the new captures and recaptures shall be presented (see Section 3.1 for guidelines). Population estimates will be calculated. Comparisons of species composition and number will be made between vegetation types and between the interim and baseline populations.

The analyzed data shall be reported in the second semi-annual report. The initial semi-annual report will contain a detailed discussion on the objectives and methods, including location of trap lines, vegetation types, aspect and identification.

Monthly status reports (Attachment I) will be submitted on the eighth day of the month.

2.2.5 Avifauna Studies

Previous RBOSP avifauna investigations on Tract C-a have included determination of seasonal variations in songbird population composition, distribution and abundance. Raptor surveys and waterfowl surveys have also been conducted. These studies will conclude with the end of the baseline data accumulation program in August 1976.

2.2.5.1 Objectives

Avifauna field studies during the interim monitoring period will be conducted on selected species during the breeding season (May-June 1977).The objectives of this census are to: estimate breeding bird population levels, determine the breeding bird species composition in each major habitat type and add to baseline information data on territory size and reproductive effort of important songbirds of the Tract C-a and 84 Mesa study area.

2.2.5.2 Methods

The breeding bird census will center on important species of the study area including: mourning dove, vesper sparrow and

Brewer's sparrow. This list may be redefined following detailed analysis of baseline data.

Three major habitat (vegetation) types of the Tract C-a and 84 Mesa study area will be censused during late spring (1977) (i.e., sagebrush, pinyon-juniper and mixed brush vegetation). Survey plots will be placed within representative homogeneous tracts of these vegetation types after these tracts are delineated by a NUS plant ecologist from existing aerial photographs and maps and/or on-site surveys.

A 12-hectare study plot (400 m by 300m) will be established in each vegetation type and divided into 1-hectare units which will be used for this census. Each corner of the 1-hectare units will be individually marked to facilitate subsequent mapping efforts which will follow procedures outlined by Hall (1964) and Robbins (1970). A qualified observer will complete at least 3 replicates of each individual 1-hectare plot and record species, siting location, nest location, nest contents and reproductive status of observed avifauna. Since a number of environmental factors such as wind speed, precipitation, cloud cover, etc., can effect the behavior of avifauna, observations will be made only under suitable conditions. At the end of three replicates, a composite map will be drawn showing locations of the territories and nests of species encountered. Analysis of these maps will provide an indication of species densitites, relative territory size and reproductive effort for each 12-hectare plot.

2.2.5.3 Sampling Frequency

The breeding bird census will be conducted in late spring (1977) by NUS.

2.2.5.4 Data Analysis and Reports

Data collected will be presented within a logical time frame after the completion of the field effort. After the data collection period, the raw data on the count of breeding birds observed and their estimated densities shall be presented. The bird count data will be correlated with appropriate meteorological data (see Sections 2.1.2.1 and 2.1.4). Because the census technique is a mapping technique, the data may not be computer compatible with existing baseline data which was collected using the Emlen (1971) strip census method. However, major population changes of important species should be identifiable. Comparisons of species composition and number within each vegetation type, between vegetation types, and between the interim and baseline populations will be made.

The analyzed data shall be reported twice yearly by NUS. The initial semi-annual report will contain a detailed discussion on the objective and methods, including a map indicating the sampling locations, vegetation types, aspect, and plot identification for each plot.

Monthly status reports (Attachment I) will be submitted on the eighth day of the month.

2.2.6 Threatened and Endangered Species

The occurrence of any endangered or threatened species will be reported immediately to RBOSP, who will report to the AOSS. A program will be designed to collect data on any such species sighted. During the baseline data accumulation program, the greater sandhill crane (a state endangered species if breeding in the state) and the whooping crane (federal endangered species) were observed in the vicinity of Tract C-a. In addition, a peregrine falcon (federally endangered) was observed soaring in the vicinity of Tract C-a. Studies will either be developed following any sighting or integrated into existing programs for these endangered species.

2.2.6.1 Objectives

This program will be performed to provide additional information on the use of Tract C-a, 84 Mesa and adjacent areas by threatened or endangered species, and to establish their current status in the area. In particular, the following program has been developed for greater sandhill cranes, however, the general nature of the program does not preclude sighting of additional endangered or threatened species.

2.2.6.2 Methods

Ground surveys, conducted both on foot and by vehicle, will be initiated in the spring (1977). The survey will begin at the onset and cease at the end of migration as determined from contact with state and federal wildlife authorities. An effort will be made to coordinate studies by the BLM, DOW and Fish and Wildlife Service to maximize effectiveness of the coverage.

Upon the sighting of greater sandhill cranes, the observer will record species, number, age class (if determinable), location, time of day and weather conditions (the present day, the previous night and any known forecast). While observing the birds, any change in weather conditions will be recorded. The observer will remain with the birds (within a safe observation distance) until they leave the area. During this observation period, the observer will record signigicant behavioral patterns. As soon as birds leave the area, the observer will report to RBOSP and the responsible agencies.

Monthly status reports (Attachment I) will be submitted on the eighth day of the month.

Ground surveys will be conducted by NUS (when possible assisted by one or more of the agencies) for three weeks in the spring (1977). Areas to be surveyed include Tract C-a, 84 Mesa, Stake Springs Pond, Stake Springs Draw and Yellow and Duck creeks. Meetings with agencies will be held early in the program to determine level of responsibility. Since agencies have not provided adequate ground coverage in the past, NUS proposes to fulfill this responsibility.

2.2.6.3 Sampling Frequency

Sandhill crane studies will include a spring survey which will occur between mid-March (1977) and mid-May (1977).

2.2.6.4 Data Analysis and Reports

Semi-annual reports will be prepared by NUS. The second semi-annual report will cover the spring migration period and will present conclusions regarding the status of cranes in the area. Important deviations from baseline observations will be identified and discussed.

2.2.7 References

Batcheler, C.L. 1975. Development of a distance method for deer census from pellet groups. J. Wildl. Manage. 39(4): 641-652.

Cole, G.F. 1973. Range survey guide. United States Dept. of the interior, National Park Service, Washington, D.C.

Emlen, J.T. 1971. Population densities of birds derived from transect counts. Ank 88: 323-342.

Hall, G. 1964. Breeding-birds census - Why and how, Aud. Field Notes 18:413-416.

Kufeld, R.C. 1968. Use of paint for marking deer pellet groups. J. Wildl. Manage. 32(3): 592-596.

Neff, D.J. 1968. The pellet-group count technique for big game trend, census and distribution: A Review. J. Wildl. Manage. 32(3): 597-614.

Robbins, C. 1970. Recommendations for an international standard for a mapping method in bird census work. Aud.Field Notes 24(6) 723-726.

United States Department of Agriculture, Forest Service. 1970. Range Environmental Analysis Handbook, 2209.21R3. United States Department of Agriculture Forest Service.

2.3 Hydrology

NUS understands that all hydrology studies described in the RFP are currently being conducted by Wright Water Engineers (WWE) under contract to RBOSP and that this arrangement will continue through most, or all, of the Interim Monitoring Program. NUS, as part of the project management task, will coordinate the hydrologic studies of WWE and the USGS in order to assure timely completion of hydrologic and water quality data collection and analysis. NUS also proposes to receive the results of the interim monitoring program, to review them for completeness and to integrate them into the semi-annual reports.

If required, NUS hydrologists could assume full responsibility for the ongoing hydrologic studies.

2.4 Aquatic Studies

2.4.1 Aquatic Biology

2.4.1.1 Objectives

The objectives of the aquatic biology program for the interim monitoring are to monitor important biotic and physical components in the surface waters of Tract C-a and/or vicinity during the suspension period and provide information on trends or changes in populations of these organisms.

2.4.1.2 Methods

Biological methods for the aquatic program are outlined below:

Benthos

Benthos will be sampled from the following stations:

- Corral Gulch - The sampling station will be located at the USGS gaging station on Corral Gulch, just as it leaves Tract C-a. This station corresponds to aquatic baseline program Station Number 13.

- Yellow Creek - The sampling station will be located near the USGS gaging station now located on Yellow Creek near the White River. This station Corresponds to aquatic baseline sampling program Station Number 20.

- White River - This sampling station will be located in a side channel approximately 30 m downstream from the confluence of the White River and Yellow Creek. It corresponds to aquatic baseline sampling program Station Number 29.

Two replicate samples will be collected in a riffle area in the center of the side channel of the White River and in the stream center at the Yellow Creek and Corral Gulch study area. A modified Surber sampler will be utilized for sampling. Samples will be washed through U.S. Standard Number 30 sieve, preserved with buffered 10% formalin, bottled and sent to the laboratory for analysis of species composition and relative abundance.

Standard methods of sample processing and analysis will be utilized in the laboratory. The benthic samples will first be agitated and the organisms rinsed into 8-inch No. 60 sieves, with light-pressure fine spray to remove any fine sediments. The samples will then be hand-sorted under dissection microscopes at 6x magnification.

Organisms will be removed from the sample with forceps, and stored in plastic capsules and 4-dram vials in 70% ethanol. Samples will be systematically searched, pushing examined portions aside. All plastic capsules and 4-dram vials for a given sample will be stored together.

With few exceptions, benthic organisms are identifiable to generic level without the use of special preparation. The standard procedure will be to identify the organisms to the lowest taxon possible. Identifications of individuals are usually made under the dissecting microscope or with temporary slides (under water) using a compound microscope.

Chironomidae, Simuliidae, and Oligochaeta are cleared in xylene and then mounted on permanent slides in Canada balsam. Only complete oligochaetes with intact anterior portions are used in enumeration.

After identification and enumeration, specimens are separated by lowest identifiable taxon and are stored in sample jars in 70% ethanol, collectively by sample replicate. A special reference or voucher collection is maintained apart from the other specimens.

Only those individuals which were living at the time of collection, as indicated by presence of fleshy tissue, are enumerated for the purpose of estimating populations. Empty mollusc shells, exuvia, reproductive structures, etc., will be retained as aids in identification and compilation of qualitative species lists, but will not be used for estimates of population densities.

Benthos samples will be taken twice a year (once in spring and once in fall) and coordinated with the water chemistry sample collections.

Periphyton

Duplicate periphyton samples, 50 cm^2 each, will be collected from flat rock surfaces at each station utilizing a knife and toothbrush. Samples will be collected from a riffle area in the middle of the side channel of the White River, and in the middle of the Creek and Corral Gulch. Samples will be collected once in spring and once in fall and coordinated with water chemistry sample collections.

These samples will be analyzed in the laboratory for cell density, species composition and relative abundance. The results will be compared to appropriate data from the baseline program.

- Lab methods - The preserved periphyton samples will be diluted to a constant volume and an aliquot will be removed, centrifuged, and washed with distilled water. The samples will then be dehydrated and stained in the centrifuge, using successive spinnings and decantings. The following stains and alcohol will be used for the periphyton preparation:
  a) Water rinse
  b) Acid fuchsin stain (aqueous)
  c) Water rinse
  d) 50% isopropanol
  e) 90% isopropanol
  f) 100% isopropanol rinse
  g) 100% isopropanol rinse
  h) xylene rinse
  i) xylene rinse

  A number of drops of the final xylene-periphyton suspension will be placed on a microscope slide with Hyrax, heated gently, and covered with an ultra-thin cover-glass. The final mounts will be retained in the permanent voucher collection.

- Periphyton will be counted from one randomly chosen transect at 1000x (oil immersion). All organisms appearing in this field will be identified and counted. The whole slide will then be surveyed at 100x to identify and enumerate larger rare species. Counts will be expressed as cells per unit area; these data will be used to compute relative abundance and species diversity.

The following will be determined concurrently with the collection of biological data:

1. Stream flow velocity at bank side and at maximum flow point at each station, measured with Gurley flowmeters or an equivalent device.

2. Stream substrate at each station, visually classified at the same time that benthic samples are obtained.

3. Field measurements of dissolved oxygen, with a YSI dissolved oxygen meter (Model 51A) or with the Alsterberg-Azide modification of the Winkler Method.

4. Determinations of pH, made in the field with a Leeds and Northrup portable pH meter (Model No. 7417) or with Analytical Measurements, Inc. portable meter (Model No. 107).

5. Salinity (conductance) measurements with a Beckman RB-3 Solu-Bridge or equivalent.

6. Temperature measurements, taken in the field with a Montedora-Whitney Thermister (Model 7510LA or equivalent).

7. Depth measurements, with a calibrated steel range pole.

8. Width measurements, with a steel tape measure.

2.4.1.3 Sampling Frequency

Aquatic biology samples will be taken twice a year (once in fall and once in spring) and sampling will be coordinated with collection of water chemistry samples.

2.4.1.4 Data Analysis and Reports

Aquatic biological data will be reported twice yearly. In each semi-annual report, the raw data for periphyton (species composition and cell density) and benthos (species composition and relative abundance) shall be presented. The initial semi-annual report will include a discussion of the objectives and methods. In addition, periphyton and benthos community dynamics will be related to the physical and chemical data obtained by the USGS and comparisons of interim monitoring data will be made with baseline data to identify any correlations, trends and significant differences in data collected during the two periods.

During the interim monitoring program NUS will submit monthly progress reports summarizing the status of field, laboratory, and office activities.

Monthly status reports (Attachment I) will be submitted on the eighth day of each month.

PART 3

DATA ANALYSIS

3.1 Analysis of Interim Monitoring Data

The guidelines used for the statistical analysis will be those that permit optimal statistical power against possible alternatives. An assessment of the power of a statistical method will be defined in terms of:

1. increasing the intensity/frequency of the sampling program

2. modifying the design criteria so as to decrease the amount of variability present

3. changing the type-I to type-II errors

4. increasing the minimum effects of interests for the alternatives

In all events, attempts will be made to select a design and a statistical method that will result in the highest power for a given type-I errort, and, thus, assure an optimal statistical method.

The optimality of a statistical method is usually demonstrated in terms of how seriously inferences are invalidated by violations of the underlying assumptions made in deriving the method. Statistical methods insensitive to violations of the underlying assumptions are called robust. In applications where the underlying assumptions are apt to be violated, the selection of a statistical method that is robuts can be of considerable practical importance, particularly if its power is not much lower than that of the optimum test and the optimum test has not been developed. Consideration of (1) the hypotheses being tested, (2) the statistical method employed to perform the test, (3) the severity of any violations of the underlying assumptions, and (4) the robustness of the method with regard to type-I errors, will be undertaken prior to implementing any non-parametric or distribution-free methods.

3.2 Analysis and Utilization of Environmental Baseline Data

Initially, NUS will review the environmental baseline data and will consult with the baseline studies contractors to identify those parameters which will be subject to detailed analysis, synthesis, and interpretation. At the completion of this effort, a final baseline report will be prepared. This report will present an integrated description of the environment of Tract c-a and its surroundings based upon the review and analysis of baseline data and results which are availabe from the interim monitorng program. This report will describe the physical, chemical and biological characteristics of Tract C-a and will discuss the interrelationships of ecosystem components.

3.2.1 Objectives

The objectives of baseline data analysis and synthesis are:

1) integration of baseline data into a final report format and

2) an enhanced understanding of the Tract C-a ecosystem

3) revisions of the development monitoring program, based on the results of the data analysis and interpretation

An enhanced understaind of the ecosystem on Tract C-a will be derived from analysis of the following:

- ecosystem interactions (interrelationships)
- ecosystem critical pathways
- sensitive components of the ecosystem
- statistical relationships of ecosystem components
- air quality

3.2.2 Methods

Initially, NUS will review the environmental baseline data critically and will consult with the baseline studies contractors in order to select those parameters which will be subjected to detailed analysis, synthesis, and interpretation.

The following paragraphs describe the general approach to be utilized by NUS in reviewing, analyzing, and synthesizing baseline data. Detailed analytical and synthesis methodologies will be developed after the initial data review. In developing these methods, NUS will utilize the services of Dr. J. Warner who has current experience with similar arid systems, as well as NUS staff.

Major effort will be made to reduce all aspects of baseline data to its most useful form. Maximum use will be made of graphic representations such as:

- Histograms of total daily insolation by month over the 2-year baseline period.
- Line graphs of temperature differences (Maximum, Minimum) at the 10 and 60 meter levels over the 2-year period.
- Histograms of wind speed over the 2-year period.
- Line graphs of population densities of mice for each sample location during each sampling period.
- Plots of number of new species versus time (species area curves) during the 2-year period.
- Graphs of soil trace metal content at various depths.

In addition, data will be summarized by year; month; day; for the 2-year period; season; location/sampling site; habitat (for biotic components); functional group; similarities and differences where appropriate.

Once data reduction has been completed, the data will be carefully studied and selection of parameters for further analysis will be made on the basis of:

- Its function as an indicator of perturbation
- Its value in describing baseline conditions (stability)
- The validity and quality of the available data

- The type of data available
- Repeatability of data collection
- Quantity of data available
- Relationships and comparability with other parameters (biotic and abiotic)

If deemed feasible after agency consultation, selection of parameters on basis of the above will be made through a group decision making technique.

All analytical methods used will have a logical, mathematical and/or statistical basis. Interrelationships of various components in the ecosystem will be identified utilizing one or several methods such as simple linear regression, product-moment correlations, multiple regression, analysis of variance, principal component analysis, species area curves, paired T-tests, Chi square determinations of associations or coefficients of variation.

After the important ecosystem pathways have been identified, parameters which are most sensitive to environmental changes can be incorporated into a revised development monitoring program. The results of this data analysis and synthesis will be incorporated into the final baseline report and into a revised development monitoring program.

3.2.3 Rationale

It is highly unlikely that oil shale development will affect constant climatic parameters such as insolation, temperature and precipitation patterns. Therefore, use can be made of baseline, interim, and operational data to test by statistical means that:

1. H_o - There is no significant difference between long term temperature averages, between baseline and interim periods, and

2. H_o - There is no significant difference between long term temperature averages between baseline and operational phases.

If null hypothesis number 1 were to be disproven, this would indicate a natural variation since no disturbance has occurred. If a similar change were to occur after operations being (No. 2), a statement could be made that the change was probably not due

to development, but the result of natural variation.

If both hypothesis prove to be correct, this also supports the contention that operation is not affecting the parametic studies.

Similar logic can be applied for other parameters and is especially useful for indicator species such as:

- Rare plants
- Seed eating mammals
- Raptors
- Vagile (invader) plants
- Bats

The above mentioned null hypothesis can be tested for presence, abundance, association and distribution for the biotic components and for temporal extent, spatial distribution, maxima, minima, means, totals, and correlations for the abiotic component.

In some cases, qualitative indicators may be more important than statistical comparisons. The nature of the data available for Tract C-a make analysis of functional groups highly viable. These functional groups (such as perching raptors-soaring raptors; nocturnal-diurnal raptors; seed-eating insect eating mammals, etc.) will be examined to determine current baseline status for comparison with interim and operational data. Changes in functional groupings can be an indicator of perturbation, especially for organisms known to be sensitive to stress. For example, seed-eating mammals (mice) are known to concentrate trace metals by eating seeds, which have assimilated trace metals from soils. Declines in seed-eaters in conjunction with baseline and operational data on trace metal content of fat can be used to establish the nature of the perturbation. Some raptors (ravens) are known as disturbance species. Therefore, an increase in number of ravens during operation over baseline indicates pertubation. In addition, certain species of plants tend to invade plant communities when disturbance occurs. Analysis of plant communities before and after operation can be used to develop an index of perturbation.

The rationale presented here can be applied to air quality and meteorological data, to soils and sediment data, and to biotic data.

A few of the data sets to be subjected to this type of scrutiny include:

- Air temperature data
- Precipitation data
- SO_2 data
- Particulate data
- Soil chemistry data (between types of soils, between vegetation types)
- Sediment data (also in correlation with soils data)
- Trace element data (soils, plants, animals, when available)
- Insolation data (solar thermal units)
- Vegetation data (joint occurrences, stability of strata)
- Functional groups (raptors, seed eaters, insect eaters)

PART 4

REPORT INTEGRATION

4.0 Report Integration

Final baseline reports will be reviewed in view of results of baseline data analysis to formulate an interdisciplinary report which presents the "overall picture" of the Tract C-a ecosystem. This report will bring together all aspects of the baseline program and will interrelate miscellaneous data parameters with other aspects of the program. This report will be prepared according to guidelines prepared and distributed by CDM/Limnetics dated December 3, 1976. Carera ready copies will be delivered to RBOSP. Two copies of the draft report and five copies of the final report, plus the original will be delivered.

PART 5

SCHEDULE

SCHEDULED EVENTS - RBOSP INTERIM STUDIES

Activity	Mo. Wk.	Nov. 1234	Dec. 1234	Jan. 1234	Feb. 1234	Mar. 1234	Apr. 1234	May 1234	Jun. 1234	July 1234	Aug. 1234	Sept. 1234
Scope of Work Preparation		———										
Scope of work and Contract approval			———									
Field Studies					———	———	———	———	———	———	———	
Atmospheric												
Terrestrial												
Range Production & Utilization							x (Set up plots)					x
Browse Condition & Utilization			x					x				x
Mule deer			x (Set up plots)					x				x
Small mammal								x				
Breeding bird								x				
Sandhill crane							(3 weeks)					
Hydrology 1/												
Surface water gaging stations												
Water quality								x				
Alluvial groundwater			x					x				
Deep groundwater				x				x				
Monitoring wells					———	———	———	———	———	———	———	
Aquatic biology			x					x				

1/ To be conducted by WWE and USGS.

(Continued)

Activity	Mo. Wk.	Nov. 1234	Dec. 1234	Jan. 1234	Feb. 1234	Mar. 1234	Apr. 1234	May 1234	Jun. 1234	July 1234	Aug. 1234	Sept. 1234
Data Analysis												
Baseline data												
Planning & Coordination												
Review												
Analysis & Correlation												
Interpretation												
Interim data												
Analysis & Correlation												
Interpretation												
Reports												
Interim Monitoring												
Monthly		x	x	x	x	x	x	x	x	x	x	
Semi-annual						▲						▲
Final Baseline Reports												
Review												
Atmospheric												
Aquatic												
Terrestrial												
Soils												
Cultural Resources												
Hydrology												
Integration												

PART 6

ADDENDUM

6.0 Addendum

6.1 Scope of work for the revision of the fish and wildlife management plan, the environmental assessment section and the modelling section of the RBOSP DDP.

6.1.1 Revision of the fish and wildlife plan and assessment

NUS Corporation proposes to revise the fish and wildlife management plan (Section 9, Chapter 11), the environmental assessment (Section 10) and the revegetation section of the land rehabilitation and control plan (Section 9, Chapter 8.4) of RBOSP's original DDP.

Preparation of an alternative assessment section will involve:

- Careful review of engineering plans for MIS mining
- Review of the current DDP assessment section and the determination of its applicability to the MIS mining plans
- Review of applicable statutes regulating environmental quality
- Preparation of a detailed outline
- Assessment of impacts created by MIS mining and generation of suggestions for mitigating these impacts. Long term, short term, direct and indirect impacts will be considered
- Submission of final revised sections to RBOSP by May 1, 1977

Revision of this section is based on the following assumptions:

- The environmental assessment section will be rewritten to assess impacts of the alternative mining plan (MIS) only
- Assessments will be based on results of data analysis and development plans

- Impacts to air quality will be discussed under Section 9, Chapter 5 in the air quality control section and referenced, only, in Section 10

- Assessments of impacts to hydrology and associated mitigations are to be prepared by WWE. NUS will serve only in a review and integration capacity.

Revision of the fish and wildlife management plan (F & W Plan) will involve:

- Careful review of the current plan (January 1-30, 1977)

- Careful review of modified in situ (MIS) mining and development plans (input from engineers)

- Review and summarization of existing stipulations; review of RBOSP legal limitations and philosophy

- Preparation of a detailed outline

- Review of impact assessments associated with the MIS project (revised as a part of the other environmental tasks)

- Revision of the current plan to reflect new potential impacts associated with MIS mining and the preparation of an alternate plan for use during this (MIS) alternative which will assure compliance with applicable statutes

- Preparation of mitigation measures to lessen or avoid the impacts associated with MIS mining

- Submittal of an alternate F & W Plan by May 1, 1977

This revision will be based on the following assumptions:

- RBOSP does not wish to retract from the commitments made in the original plan, nor do they wish to become commited to sole responsibility for financing habitat enhancement plans.

- The F & W Plan will be revised to reflect changes in mining plans, associated impacts and mitigations, but will not be revised to reflect a change in philosophy.

- Impact assessments contained within the F & W Plan will correspond and be taken from the environmental assessment section of the DDP (which will also be revised to reflect MIS mining plans by NUS).

- This F & W Plan will be written to stand alone as a separate document, if necessary, and will follow the format of the previous F & W Plan.

- The F & W Plan will be an alternative plan, not intended to supercede or replace the original plan, but only to reflect changes in project description for MIS mining.

- The monitoring subpart of the F & W Plan will be revised to reflect changes in the monitoring plan.

Revisions will be generated for the revegetation section of the land rehabilitation and control plan (Section 9, Chapter 8.4) to conform to the MIS mining plans. Maximum use of existing information will be made and a revegetation program compatible with MIS plans will be formulated.

NUS will prepare and submit two copies of draft F & W Plan Environmental Assessment, and Revegetation sections on April 15, 1977. Revisions made by RBOSP will be incorporated and final reports (two copies) submitted on May 1, 1977. Since revision time is very short, NUS requests that RBOSP respond with their comments within 8 days of draft submittal. Final report sections will be camera ready and in the format designated by RBOSP.

6.1.2 Scope of work for revising the modelling sections of the DDP and modelling to conform to the MIS concept RBOSP

NUS will revise subpart 5.7 of Section 9, Chapter 5 to apply to MIS mining plans, including the selection of an appropriate diffusion model, application of the model using Tract C-a atmospheric data, interpretation of results and revision of the section on a cost plus basis.

The MIS development of Tract C-a presents a different set of air quality considerations than the original open-pit mining concept. The greatest change is in the position and elevation of the principal gaseous emission discharge(s). The ground level emissions with the high frequency of surface based night time inversions will result in frequent trapping of emissions as opposed to the elevated release from stacks.

Following an initial review of site topography, meteorology and the results of the application of the valley model with the assumptions inherent in the open pit mining concept, NUS modelling personnel strongly recommend the application of the CRSTER model. Offsite upper air data (in lieu of Holzworth averages) and onsite hourly met data will be used to link met information from monitoring sites 1, 2 and 3 and formulate the complete annual meteorological data set. The MIS development concept produces a source which moves in time resulting in a continually changing terrain factor over the life of the project. With the current development plan, the primary initial impact due from retort gaseous emissions will occur offsite due to the area's prevailing winds. In addition, the orientation of the surface area divisions for retorting are presently such that the prevailing winds will cause emissions from separate, but adjacent, retorts to combine and produce greater downwind concentrations than if the proposed divisions were oriented at right angles to the prevailing winds.

NUS will obtain offsite upper air data from Grand Junction, Colorado and Lander, Wyoming and compare the data with the baseline seasonal measurements taken onsite. The most representative upper air data source for each season will be chosen and the data on actual mixing heights assembled for input to the model. Source terms will be prepared, and terrain factors determined using the geometric center of the proposed MIS for each of the five initial years and for the 5-20 and 20-30 year development plots.

Following the assembly of all of the input data, NUS recommends meeting with EPA Denver Regional Office personnel to present a detailed review of the proposed modelling effort, the justification of the input data terms, and the output terms to be calculated.

This meeting should include CDOH personnel in an attempt to satisfy their comments in their letter to the AOSS of July 27, 1976, wherein on page 3 under item A2(4) it is implied that CDOH reserves the right to verify the methodology NUS will provide documentation covering the proposed model application in advance of such meeting so that the plan may be reviewed by all parties prior to the meeting.

NUS will run the valley model and a CDM model using the annual site meteorological data set. The results of these two models will be compared to determine the most representative application for long-term impact analysis. The results of these calculations will provide the basis for future offsite monitoring, if required.

If the CRSTER modelling results produce calculated predictions of excessive ground level pollutant concentration, NUS will recommend the extension of this proposed study to include the modelling of a set of maximum day observations by a flow field analysis. This analysis is more precise, site and time specific and less conservative than CRSTER since it allows for additional dispersion due to plume meander, variation in emission rates, plume travel time, varying mixing depths, wind shear dispersion and other factors affecting the actual emissions. This extension is not contemplated at the present time, and would only be employed if the conventional modelling provides marginally unacceptable ground level pollutant concentrations in violation of possible air quality standards estimated by the model uncertainties.

6.2 SCHEDULE

SCHEDULED EVENTS FOR DDP REVISIONS

Activity	Month / Week	December 1 2 3 4	January 1 2 3 4	February 1 2 3 4	March 1 2 3 4	April 1 2 3 4	May 1 2 3 4
Proposal Preparation							
Approval, contract award							
Assessment							
Section 9, Chap. 5.7 (Modelling)							
Step I							
Step II							
Step III							
Section 11							
Step I							
Step II							
Step III							
Fish and Wildlife Management							
Step I							
Step II							
Step III							
Revegetation Plan							
Section 9, Chap. 8.4							
Step I							
Step II							
Step III							
Milestones							

ATTACHMENT I.

NUS MONTHLY STATUS REPORT

PROGRAM: _____ MONTH ENDING: _____

TASK: _____ TASK LEADER: _____

PLANNED - START: _____ COMPLETE: _____

ACTUAL - START: _____ COMPLETE: _____

TOTAL MAN HOURS ALLOCATED - hours

	MAN HOURS	%	PROG. MGR. EST. % OF COMPL.
PLANNED EXPENDITURES TO DATE			
ACTUAL EXPENDITURES TO DATE			

A. Task Performance During Reporting Period

B. Identify Problems and Recommend Solutions

C. Forecast of Activities for Next Reporting Period

D. Program Highlights and Important Meetings

NUS Corporation utilizes management, engineering and scientific skills to solve problems in the fields of fossil and nuclear energy, environmental engineering, water management, pollution control, information management systems and related technologies.

NUS CORPORATION

4 Research Place, Rockville, Maryland 20850 (301) 948-7010 TWX 710-828-0540

Offices in Pittsburgh; Los Angeles; San Diego; Houston; Portland, Oregon; Dunedin, Florida; and international offices in Brazil, Germany, and Japan.